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AIR QUALITY SURVEY (TAGA 6000)
FIBERGLAS CANADA INC., GUELPH
AUGUST, 1989

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Executive Summary

During the period of August 8 to 18, 1989, the mobile TAGA 6000 unit of the Air Resources Branch performed an air quality survey in Guelph, at the request of the West Central Region. The survey objectives were to identify and determine the ambient concentration of the odourous pollutants in the vicinity of three distinct manufacturing plants: Fiberglas Canada fabric plant, located at 247 York Road; Fiberglas Canada chemical plant, located at 38 Royal Road; and National Magnet Wire, located at 545 Speedvale Avenue W., immediately west of the Fiberglas Canada chemical plant. During the two week survey period, National Magnet Wire was shut down until August 15, 1989. Unfavourable winds and limited viable access in the vicinity of the plant made it impossible to monitor downwind of National Magnet Wire on days the plant was reportedly in operation. Thus, the survey focused mainly on the two Fiberglas Canada plants. The West Central Region, because of an abatement programme at Fiberglas Canada, requested that monitoring of the Fiberglas Canada fabric plant be conducted before and after the replacement of incinerating equipment.

A "burnt" odour was frequently present downwind of the east end of the Fiberglas Canada fabric plant prior to the installation of the new incinerator. Concentrations of odourous compounds were too low to be detected in the real time with the TAGA, so a chemical fingerprint of the burnt odour was unattainable. The burnt odour was not detected following the installation of the new incinerator. Diacetone alcohol was the most abundant pollutant present downwind at the west end of the Fiberglas Canada fabric plant. The "sharp" and "fruity" odour at the west end was quite different from the burnt odour at the east end. A total of 16 half-hour average concentrations of diacetone alcohol were determined. The ambient diacetone alcohol concentrations ranged from "not detected" to 18 $\mu g/m^3$. The Ministry guideline, based on odour, for diacetone alcohol is 990 $\mu g/m^3$.

Styrene odours were strong but intermittent downwind of the Fiberglas Canada chemical plant throughout the monitoring period. A total of 11 half-hour average concentrations of styrene were determined. The ambient styrene concentrations were 11 to 63 $\mu g/m^3$, well below the Ministry standard of 400 $\mu g/m^3$, although frequently the instantaneous levels of styrene exceeded 200 $\mu g/m^3$ which is greater than some of the odour thresholds published in the scientific literature.

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1.0 Introduction

At the request of the West Central Region, the mobile TAGA 6000 unit of the Air Resources Branch recently conducted an air monitoring survey in Guelph in the vicinity of the two Fiberglas Canada plants: the fabric plant at 247 York Road and the chemical plant at 38 Royal Road. Attempts were made to monitor a third plant, the National Magnet Wire (NMW) plant at 545 Speedvale Avenue W. The Region specifically requested that the Fiberglas Canada fabric plant be monitored before and after the installation of a new incinerator, which took place on August 10, 1989.

The NMW plant was shut down until August 15, 1989. In addition, unfavourable winds and limited viable access in the vicinity of the plant made it impossible to monitor downwind of NMW. Thus the survey focused mainly on the two Fiberglas Canada plants.

The Fiberglas Canada fabric plant manufactures fibreglass textile and reinforcement materials. The Fiberglas Canada chemical plant manufactures fibreglass resins. A brief description of the plant processes and relevant production information from both plants is supplied in the Appendix.

Presented below is the analysis of air samples acquired downwind of both Fiberglas Canada plants as determined in the field by the mobile TAGA 6000 unit during the survey period of August 8 to 18, 1989.

2.0 The TAGA 6000 "Fingerprinting" Technique

The Trace Atmospheric Gas Analyzer (TAGA) model is a specialized tandem mass spectrometer (MS/MS) with a unique air sampling inlet system and ion source (see Figure 1). Ambient air is sampled directly at a high flow rate (100 l/min.) into the ion source, which is operated at atmospheric pressure. Ionisation of trace contaminants is achieved by chemical ionisation (CI) initiated by a corona discharge. Selective ionisation of chemical classes is achieved through the addition of an appropriate CI reagent to the flowing air sample. For example: atmospheric water vapour highlights ketones, aldehydes, alcohols and acids; oxygen highlights phenols, chlorophenols and acids; benzene highlights aromatic compounds and sulphurous species; and ammonia highlights amines, amides and some ethers.

The ionisation of pollutants yields a mixture of pseudo-molecular ions which are immediately subjected to mass analysis up to 250 atomic mass units (amu). Mass "fingerprinting" is achieved in a matter of minutes. The chemical or pollutant fingerprint is derived from the interpretation of all the mass spectra for a given monitoring period. Identifications bases on this method are tentative, as they are determined through considerable interpretation by the scientist. The identity of compounds present at concentrations greater than about 1 $\mu g/m^3$ can be confirmed by use of the second stage

of mass analysis to obtain a "daughter ion" mass spectrum. In this technique, the preselected ions collide with an inert gas in the mass spectrometer and subsequently undergo collisionally activated dissociation (CAD). The pattern of fragmentation is characteristic of the compound which produced the pseudo-molecular ion. The daughter ion spectra produced in the field may be computer searched against a library of known daughter ion spectra in near real-time, allowing on-site confirmation of pollutant identification. In addition, the ambient air may be screened for classes of pollutants using either a "neutral loss" scan or a "parent ion" scan. For example, it is possible to screen for chlorinated species by monitoring the neutral loss of 35 amu, the mass of the more abundant isotope of chlorine. The presence of methyl ketones could be established by performing a parent ion scan for 43 amu, the atomic mass of a daughter ion common to all methyl ketones.

Owing to this system's unique features of direct air sampling and atmospheric pressure chemical ionisation, the technique is highly sensitive to many polar organic compounds in real-time. Generally, the TAGA can detect volatile compounds which contain a hetroatom such as N, O, P, S, or a halide. The real-time limits of detection for the TAGA range from 0.1 to 10 $\mu g/m^3$, depending on the type of chemical and the complexity of the sample matrix.

The mobile TAGA 6000 unit is equipped with a meteorological station which monitors atmospheric temperature at the roof height and the wind speed and direction at a selected height between three and ten metres. Meteorological data can be simultaneously recorded by the TAGA system computer along with air quality measurements.

2.1 Quantitation of Target Compounds

Accurate quantitation of a target compound can be achieved by calibrating the response of the TAGA to known gas phase concentrations of the target compound. Fragment ions, produced through collisions with argon molecules in quadrupole 2 (see Figure 1) are characteristic of the target compound monitored in the "multiple reaction monitoring" (MRM) mode. A typical monitoring period for obtaining quantitative data is thirty minutes; this conforms to the period specified for Ministry standards and guidelines for atmospheric pollutants. The instrument is calibrated at least twice a day, usually before and after the monitoring period. Calibrations are conducted more frequently in instances where target compound concentrations exceed Ministry standards and guidelines.

Prior to any downwind monitoring of the Fiberglas Canada fabric plant, a six point calibration was performed to determine the sensitivity of the TAGA 6000 towards gaseous diacetone alcohol. Four parent-daughter ion pairs (M1/M3 = 117/99, 117/59, 117/43, and 117/31, see Figure 2) were chosen to verify the concentration of diacetone alcohol in the air samples. The sensitivity of the TAGA 6000 toward diacetone alcohol was determined by the slope of the calibration curve. Calibrations were performed three times to assess

reproducibility. Similarly, another set of calibrations were performed at the end of each monitoring day to ensure that the diacetone alcohol response factors were within QA/QC criteria. On days when monitoring was restricted to one or two half-hour periods, the second calibration was not required.

Similar procedures were used to calibrate ion signal response to styrene, a target compound of the Fiberglas Canada chemical plant. The four point calibration of styrene was performed in single-MS mode (M1 = 104), as no intense daughter ion signals are present in the MS/MS spectrum of this compound (see Figure 3). Note that during some half-hour monitoring periods, the instantaneous ambient levels of styrene were observed to exceed the upper limit for linear response as determined by the calibration curves. The styrene concentrations quoted in this report underestimate the true styrene levels.

2.2 Survey Strategy

The basic survey strategy was to position the TAGA 6000 downwind of the source to commence fingerprint mass scans to identify prospective target compound(s), and subsequently quantify their ambient concentrations. In addition to the downwind (source) monitoring, air monitoring was performed at locations upwind of the suspected source. The upwind data was used to: determine background contributions to fingerprint mass scans, determine the detection limit of the target compound, and to correct quantitative downwind measurements for background contributions. The selection of monitoring sites was based upon several observations: wind direction and wind speed, odour characteristics, type of chemicals detected (fingerprint), plume tracking information, and accessibility and road network.

3.0 Results and Discussion

The mobile TAGA 6000 unit conducted ambient air monitoring in Guelph during the period of August 8 to 18, 1989. Although the West-Central Region requested monitoring of all three plants, no monitoring was conducted at National Magnet Wire. The survey focused on the two Fiberglas Canada plants, especially the period prior to and after the installation of a new incinerator to the fabric plant.

A faint burnt odour was frequently present downwind of the east end of the Fiberglas Canada fabric plant prior to the installation of the new incinerator. The concentrations of the odourous compounds were too low to be detected in real time with the TAGA, so the chemical fingerprint was unattainable. The burnt odour was not detected following the installation of the new incinerator on August 10, 1989. Fingerprint mass scan data acquired downwind at the west end of the fabric plant during the occurrence of sharp and fruity odours indicated diacetone alcohol as the most abundant pollutant. Illustrated in Figure 2 is a comparison of the daughter ion spectrum from psuedo-molecular ions at m/z=117 with the library daughter ion spectrum of diacetone

alcohol. On August 11, 14, and 16 a total of 16 half-hour average concentrations for ambient diacetone alcohol were measured at four locations downwind of the fabric plant. Monitoring sites downwind of the fabric plant are detailed in Figure 4. The diacetone alcohol half-hour average concentrations are summarized in Table 1. Also included in Table 1 is information regarding: sampling periods, sampling locations, meteorological conditions, and daily detection limits for diacetone alcohol. All data is corrected for background or upwind contributions.

Strong intermittent styrene odours were present downwind of the Fiberglas Canada chemical plant during monitoring periods on August 15, 17 and 18. Fingerprint mass scan data indicated the major pollutant was styrene. Figure 3 is a comparison of the daughter ion spectrum of psuedo-molecular ions from m/z=104 to the library daughter ion spectrum of styrene. Acetone or propionaldehyde (m/z=59), Figure 5 and toluene (m/z=92), Figure 6 were identified as minor contaminants. On August 17, 1989 a total of 11 half-hour average concentrations of styrene were acquired downwind, on Imperial Road, southwest of the plant. Monitoring locations downwind of the chemical plant are detailed in Figure 7. The styrene half-hour average concentrations are summarized in Table 2. Note that the concentration values provided in Table 2 are estimated within a factor of two because some instantaneous levels of styrene exceeded the upper limits of the calibration concentrations.

<u>August 8</u>

This day the sky was overcast with winds initially from the west at 0 to 3 km/h and later from the NW. Background fingerprint mass scan data were recorded upwind of the Fiberglas Canada fabric plant at the parking lot of Tytler School (bounded by Ontario Street, Short Street, Toronto Street and York Road). Fingerprint mass scan data were acquired first at the south end of the municipal park parking lot, downwind of the incinerator stack in the presence of faint burnt odours. The odourous compounds were too low to be detected in real time with the TAGA. The TAGA unit then moved to the water pumping station parking lot in the presence of moderate sharp and fruity odours, downwind at the west end of the fabric plant. During the day, eighteen fingerprint mass scan data indicated diacetone alcohol was the most abundant pollutant. No other pollutant was detected.

<u>August 9</u>

August 9 was overcast, with calm SSW winds later increasing to 20 km/h. Background fingerprint mass scan data were taken at the Tytler School parking lot. The TAGA was then moved to Boult Avenue, downwind of the fabric plant incinerator. A moderate burnt odour was present during the monitoring period. Moderate sharp and fruity odours were also present at the same site. Ten fingerprint mass scan data indicated diacetone alcohol as the only pollutant.

<u>August 10</u>

This was a sunny day with winds from the SW at 3 to 7 km/h. Installation of the new incinerator at the fabric plant began prior to 07:00hrs on this date. Again, background fingerprint scan data were acquired at the school parking lot. Six downwind fingerprint mass scan data taken on Boult Avenue highlighted only diacetone alcohol.

<u>August 11</u>

This day the sky was overcast with calm SW winds. Diacetone alcohol calibrations and background measurements were performed at the Tytler School parking lot. Three fingerprint mass scan data indicated diacetone alcohol was the only pollutant and two half-hour average concentrations of diacetone alcohol (Samples number 01 and 02) were acquired downwind at 100 Harris Street, Site A, NNE of the fabric plant.

<u>August 14</u>

August 14 was a humid, partially cloudy day with winds mainly from the SW at 0 to 5 km/h. Upwind measurements and diacetone alcohol calibrations were conducted in the school parking lot. Two half-hour average concentrations of diacetone alcohol (Samples number 03 and 04) were collected at 24 Boult Avenue, Site B, east of the fabric plant and downwind of the new incinerator. The burnt odours were not present. Two half-hour average concentrations of diacetone alcohol (Samples number 05 and 06) were then acquired at 122 Harris Street, Site C, in the presence of sharp and fruity odours. Six fingerprint mass scan data from Sites B and C indicated diacetone alcohol as the only pollutant confirmed by the background subtracted mass scans.

<u>August 15</u>

This was an overcast day with calm winds initially from the SW and later from the NW. Three fingerprint mass scan of the ambient air downwind of the Fiberglas Canada fabric plant indicated the only pollutant identified by the TAGA 6000 was diacetone alcohol. The TAGA unit moved to the west end of Guelph to identify the air pollutants from the Fiberglas Canada chemical plant and if possible, the National Magnet Wire. Although attempts were made to locate the TAGA at different sites in the vicinity of NMW, the unfavourable winds, limited access, and heavy traffic along Speedvale Avenue made it impossible to monitor downwind. Background fingerprint mass scans were collected on the north side of Massey Road, upwind of the Fiberglas Canada chemical plant. Two downwind fingerprint mass scan data were acquired at Royal Road in the presence of strong styrene odours. The data indicated styrene as the major pollutant from the Fiberglas Canada chemical plant.

<u>August 16</u>

August 16 was partially cloudy with winds from the north ranging from 0 to 12 km/h. The mobile TAGA unit monitored the Fiberglas Canada fabric plant. Background monitoring and the diacetone alcohol calibrations were established at the Tytler School parking lot. No burnt odours were detected downwind of the new incinerator. Six fingerprint mass scan data highlighted diacetone alcohol as the unique contaminant and ten half-hour average concentrations of diacetone alcohol (Samples number 07 to 16) were acquired at the parking lot of the water pumping station, Site D, south of the fabric plant in the presence of sharp and fruity odours.

<u>August 17</u>

This was a clear and sunny day with winds from the NE to NW at speeds up to 13 km/h. The mobile TAGA unit monitored the Fiberglas Canada chemical plant. Styrene calibrations and background measurements were conducted on the west side of Royal Road, opposite the chemical plant. Downwind measurements were acquired at Imperial Road, SSW of the chemical plant, Site E. Four fingerprint mass scan data indicated the major pollutant was styrene with a few minor contaminants such as acetone and/or propionaldehyde and toluene being identified. A total of 11 half-hour average concentrations of styrene (Samples number 17 to 27) were collected in the presence of strong styrene odours.

<u>August 18</u>

August 18 was another sunny day with winds from the east at 3 to 10 km/h. Background measurements were made on Imperial Road, upwind of NMW. No odour could be detected downwind of NMW. Styrene odours were present and mixed with other paint solvent odours downwind of the Fiberglas Canada chemical plant near the intersection of Imperial Road and Massey Road, Site F. Three fingerprint mass scan data did not reveal any contaiminants other than styrene.

4.0 Summary and Conclusions

The mobile TAGA 6000 unit conducted an air monitoring survey in Guelph, Ontario on August 8 to 18, 1989 at the request of the Ministry's West Central Region. The primary purpose of this survey was to identify and to determine the ambient concentrations of the contaminants downwind of both Fiberglas Canada plants. The monitoring results indicated that diacetone alcohol was the dominant compound detected by the TAGA downwind of the Fiberglas Canada fabric plant and styrene was the major

pollutant detected by the TAGA downwind of the Fiberglas Canada chemical plant.

After the installation of the new incinerator at the Fiberglas Canada fabric plant the burnt odours were no longer detected by the survey crew. However, a sharp fruity odour was apparently originating from the west end of the plant, persisted despite the installation of the incinerator. A total of 52 chemical fingerprints were acquired during August 8 to 11 and August 14 to 16 downwind of the Fiberglas Canada fabric plant. Chemical analysis of the fruity odour indicated the presence of diacetone alcohol. No other pollutants were detected (above the background) during any of the monitoring periods, whether they occured before or after the installation of the incinerator. The maximum half-hour average concentration of diacetone alcohol (18 $\mu g/m^3$) was far below from the Ministry guideline of 990 $\mu g/m^3$.

Nine mass scan fingerprint data were acquired downwind of the Fiberglas Canada chemical plant on August 15, 17 and 18. Styrene was indentified as the major contaminant in all the TAGA monitoring periods. The data also indicated traces of acetone and/or propionaldehyde: both coumpounds had good library matches with the TAGA spectrum library of standard compounds as confirmed on both August 15 and 17. Toluene, the other contaminant identified, could also arise from the vehicle exhausts from vehicular traffic. The maximum half-hour average concentration of styrene (63 $\mu g/m^3$) detected downwind of the Fiberglas Canada chemical plant was well below the Ministry standard, based on odour, of 400 $\mu g/m^3$. When styrene levels were in the order of approximately 100 $\mu g/m^3$, the odour was perceived to be moderately strong. Instantaneous styrene concentrations were as high as 250 $\mu g/m^3$. Note that detection odour thresholds for styrene have been reported[1] as low as 20 $\mu g/m^3$.

5.0 Acknowledgements

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Greg Koyanagi (Consultant)
Neil Buonocore (MOE)
Frank Dobroff (MOE)
John Cooke (MOE)
Bryan Rayner (MOE)

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1. Germert van, L. J.,(central Institute for Nutrition and Food Research), Netenbreizer, A. H., (National Institute for Water Supply), Compilation of odour threshold values in air and water, Netherlands, 1977.

Diacetone Alcohol (DiAc) Half–hour Average Concentrations
Guelph (Fiberglas Canada Fabric Plant, York Rd.) Survey 1989

Date	Sample Number	Monitoring Period	Location[1]	Meteorological Conditions[2] AT	WS	WD	DiAc[3] Conc.	Det.[4] Limit	Max.[5] Conc'n.	Error[6] (RSD%)	Comments
Aug. 11	01	11:28–11:58	A	25	0–1	S–SE	ND	.68	1.0	3	7
	02	12:17–12:47	A	25	0–1	S–SE	ND	.68	3.0	3	7
Aug. 14	03	14:05–14:35	B	27	2–5	W–SW	ND	.44	6.0	6	7
	04	14:35–15:05	B	27	2–5	W–SW	ND	.44	2.0	6	7
	05	15:33–16:03	C	31	4–6	S–SW	2.4	.44	20	6	8
	06	16:04–16:34	C	31	4–6	S–SW	ND	.44	3.0	6	8
Aug. 16	07	10:36–11:06	D	23	3–6	N–NW	11	.59	70	9	9
	08	11:15–11:45	D	23	3–6	N–NW	15	.59	60	9	9
	09	11:45–12:15	D	23	3–6	N–NW	14	.59	90	9	9
	10	12:16–12:46	D	23	3–6	N–NW	15	.59	120	9	9
	11	12:48–13:18	D	23	3–6	N–NW	9	.59	110	9	9
	12	13:23–13:53	D	23	3–6	N–NW	13	.59	90	9	9
	13	13:55–14:25	D	23	3–6	N–NW	15	.59	100	9	9
	14	14:25–14:55	D	23	3–6	N–NW	18	.59	180	9	9
	15	15:05–15:35	D	23	3–6	N–NW	10	.59	70	9	9
	16	15:36–16:06	D	23	3–6	N–NW	0.9	.59	20	9	9

1. Site A: 100 Harris St, NE of Fiberglas. Site B: 24 Boult Ave., E of Fiberglas. Site C: 122 Harris St., NE of Fiberglas. Site D: Pumping Station P.L., S of Fiberglas.
2. Meterological conditions at 10 metres: AT=ambient temperature, WS=wind speed in km/h, WD=wind direction.
3. In $\mu g/m^3$.
4. In $\mu g/m^3$, based on 3σ, where σ=standard deviation of background signal.
5. Maximum instantaneous concentration of diacetone alcohol, in $\mu g/m^3$.
6. Uncertainty in diacetone alcohol concentration, based on relative standard deviation of replicate calibration runs.
7. New Incinerator, no odour present.
8. New Incinerator, sharp odour present. Odour source is not incinerator: source is likely at west end of plant.
9. Sharp odour, moderate intensity.

Table 1: Half-hour Average Concentrations of Diacetone Alcohol.

Styrene (Styr) Half–hour Average Concentrations
Guelph (Fiberglas Canada Chemical Plant, Royal Rd.) Survey 1989

Date	Sample Number	Monitoring Period	Location[1]	Meteorological Conditions[2] AT	WS	WD	Styr[3] Conc'n.	Det.[4] Limit	Max[5]. Conc'n.	Comments
Aug. 17	17	10:13–10:43	E	23	5–10	N–NE	19	2.9	120	6
	18	10:44–11:14	E	23	5–10	N–NE	17	2.9	110	6
	19	12:02–12:32	E	23	5–10	N–NE	30	2.9	160	6
	20	12:33–13:03	E	23	5–10	N–NE	26	2.9	200	6
	21	13:03–13:33	E	23	5–10	N–NE	57	2.9	250	6
	22	13:47–14:17	E	23	5–10	N–NE	37	2.9	210	6
	23	14:17–14:47	E	23	5–10	N–NE	11	2.9	170	6
	24	14:48–15:18	E	23	5–10	N–NE	19	2.9	220	6
	25	15:18–15:48	E	23	5–10	N–NE	25	2.9	190	6
	26	15:50–16:20	E	23	5–10	N–NE	63	2.9	60	6
	27	16:22–16:52	E	23	5–10	N–NE	24	2.9	17	6

1. Site E: Imperial Rd., SW of Fiberglas plant.
2. Meterological conditions at 10 metres: AT=ambient temperature, WS=wind speed in km/h, WD=wind direction.
3. Estimated concentration based on single MS data, in $\mu g/m^3$, uncertainty ± 2x.
4. In $\mu g/m^3$, based on 3σ, where σ=standard deviation of background signal.
5. Maximum instantaneous concentration of styrene, in $\mu g/m^3$.
6. Strong, intermittent styrene odour.

Table 2: Half-hour Average Concentrations of Styrene.

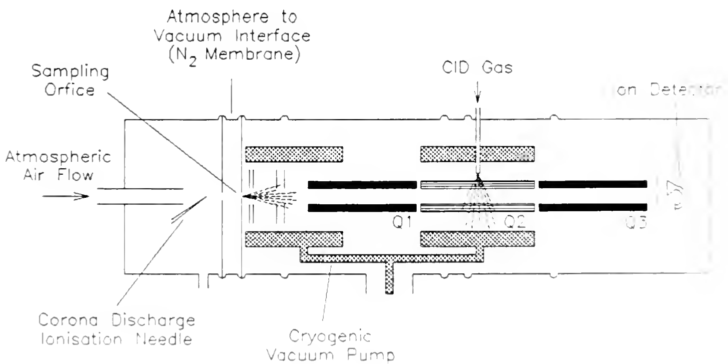
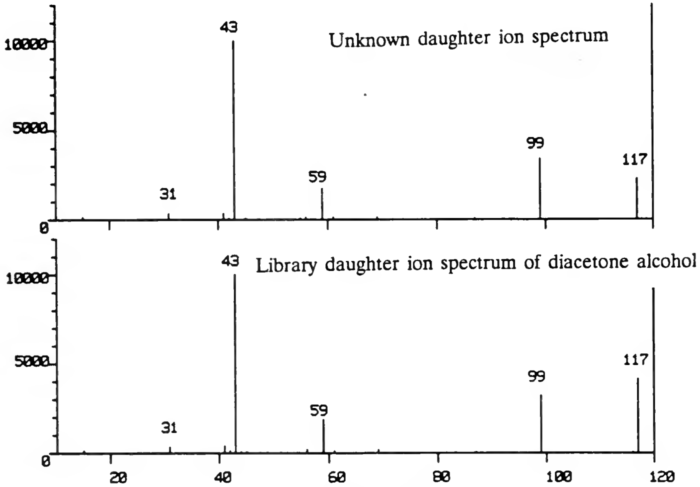


Figure 1: Schematic of the TAGA 6000 System.

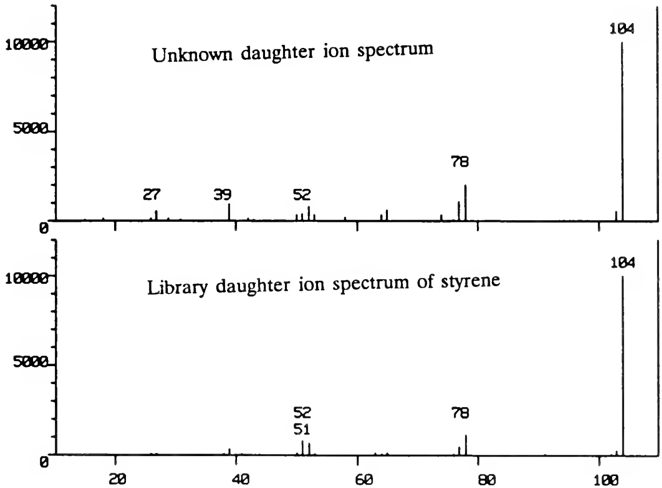


Library Search Results

Library File: SCILIB2 Parent Ion : 117

Name	Formula	Index	M.W.	Reverse	Forward
DIACETONE ALCOHOL	C6.H12.O2	82	116	1.0000	1.0000
4-OXOPENTANOIC ACID	C5.H8.O3	343	116	0.6325	0.7687
PROPYL PROPIONATE	C6.H12.O2	193	116	0.6268	0.6396
ACETONYL ACETATE	C5.H8.O3	186	116	0.5560	0.8790
HEPTYL ALCOHOL	C7.H16.O	153	116	0.5388	0.6396
ETHYL-2-METHYLPROPANOATE	C6.H12.O2	341	116	0.4376	0.6030
CAPROIC ACID	C6.H12.O2	159	116	0.4341	0.5641
METHYL-2-METHYLBUTANOATE	C6.H12.O2	342	116	0.4232	0.4767
ETHYL BUTYRATE	C6.H12.O2	179	116	0.2887	0.5222
n-BUTYL ACETATE	C6.H12.O2	201	116	0.1715	0.0000

Figure 2: Library Search Daughter Ion Scan at Boult Avenue (H_2O CI). Spectra acquired downwind of Fiberglas Canada fabric plant.



Library Search Results

Library File: BENZLIB Parent Ion : 104

Name	Formula	Index	M.W.	Reverse	Forward
STYRENE	C8.H8	33	104	0.7346	0.7385

Figure 3: Library Search Daughter Ion Scan at Imperial Road (Benzene CI). Spectra acquired downwind of Fiberglas Canada chemical plant.

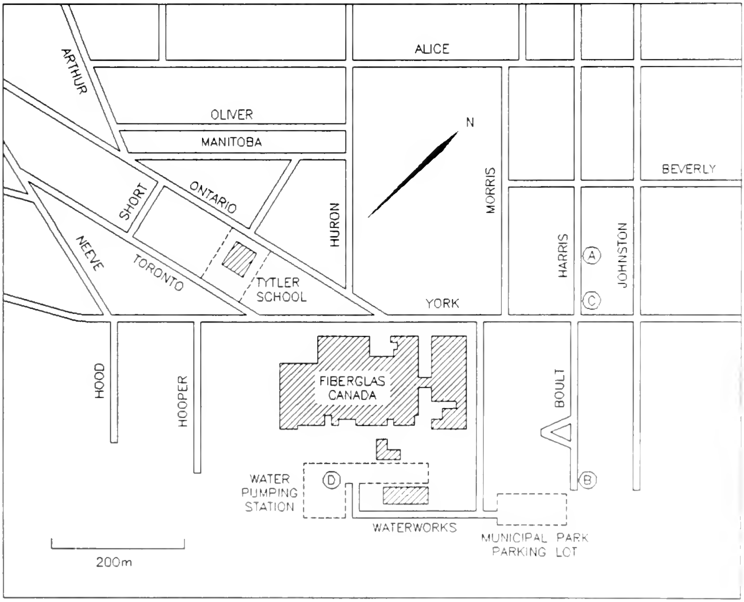
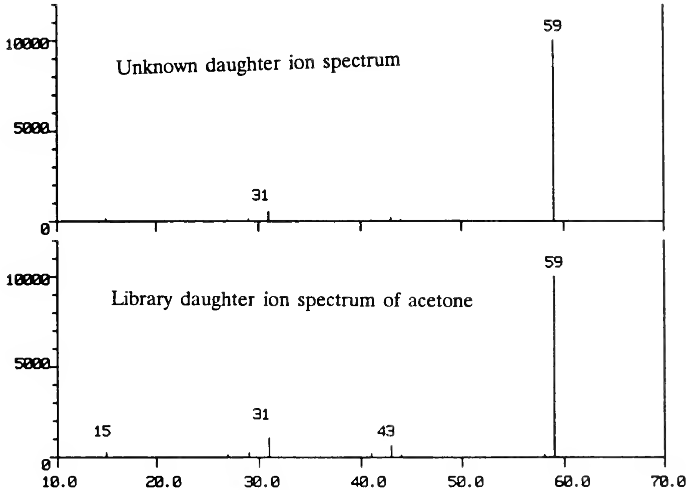


Figure 4: Map of the Monitoring Sites at Fiberglas Canada fabric plant.

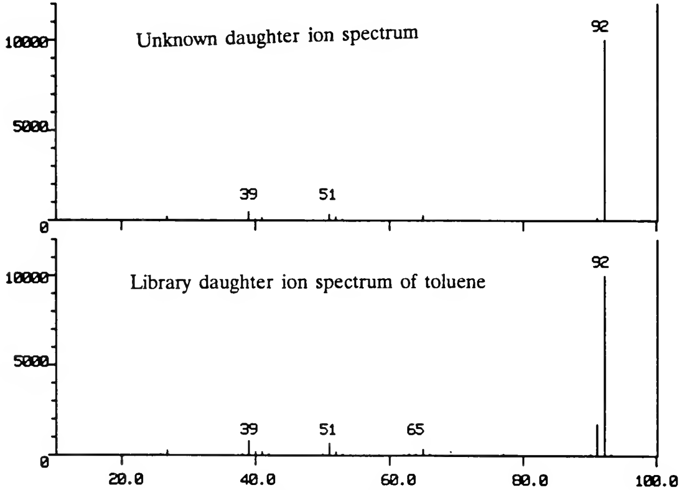


Library Search Results

Library File: SCILIB2 Parent Ion : 59

Name	Formula	Index	M.W.	Reverse	Forward
ACETONE	C3.H6.O	62	58	0.9597	0.9370
PROPIONALDEHYDE	C3.H6.O	88	58	0.8980	0.8410

Figure 5: Library Search Daughter Ion Scan at Imperial Road (H_2O CI). Spectra acquired downwind of Fiberglas Canada chemical plant.



Library Search Results

Library File: BENZLIB Parent Ion : 92

Name	Formula	Index	M.W.	Reverse	Forward
TOLUENE	C7.H8	6	92	0.8519	0.8253

Figure 6: Library Search Daughter Ion Scan at Imperial Road (Benzene CI). Spectra acquired downwind of Fiberglas Canada chemical plant.

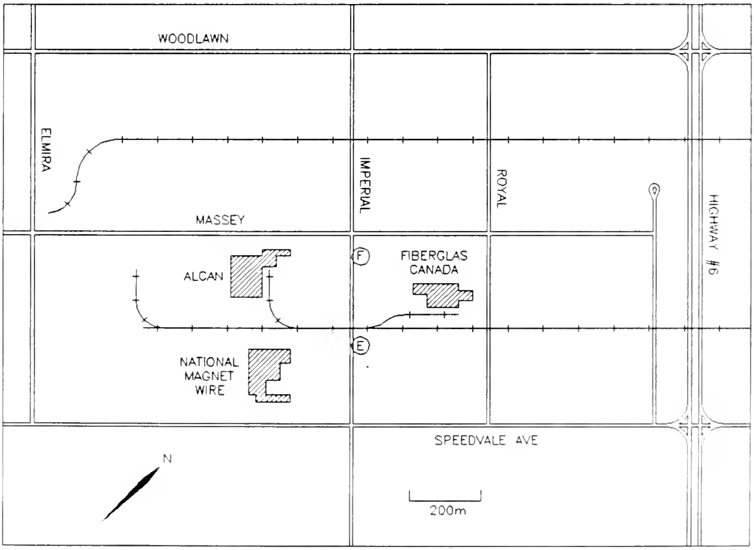


Figure 7: Map of the Monitoring Sites at Fiberglas Canada chemical plant.

6.0 Appendix: Plant Processes and Relevant Production Information.

Process Description

(A) Fiberglas Canada Fabric Plant

Glass Melting

Incoming raw materials - flint, clay, limestone and a number of minor ingredients - are received in either bagged or bulk form and stored in silos inside the batch house. Automatic equipment weighs individual ingredients into a mixer. The mixer batch is then pneumatically conveyed to storage hoppers located above the melting units.

The glass melting itself takes place in gas-fired and electric-boosted furnaces. Batch is fed into the rear of the furnace and it melts to form a molten homogeneous glass. Temperatures in the melter approach 1600°C and the glass itself, as it flows out of the front end of the melter is about 1400°C.

Forming

The glass flows into the forehearth section and exits through alloy crucibles called bushings. Each bushing plate includes 400 to 4000 tubular tips through which the glass is drawn. Fibers produced by this process range from 9 to 22 micrometers in diameter. It would take approximately 6000 kilometers of the finest individual filament produced to weigh one kilogram. As many as 160 bushings can be in operation at full production.

Although the glass is still at approximately 1200°C when it exits from the bushing, the filaments are so fine that they cool and solidify instantaneously. Sizing is then applied to provide lubrication and protection for the fibers as they are being further processed. Sizing and film formers may be starch, epoxy resin, polyester resin, aerilic resin, or combinations of these. The sizing material creates a thin coating on the glass, comprising a very small percentage of the total product weight. These fibers are then wound onto packages at speeds of up to 240 kilometers per hour. From the winding tunnel, yarn packages are taken directly to the twist and ply department; reinforcements, on the other hand, must be oven-dried to remove moisture before further processing. There are a number of drying ovens, of both the direct and indirect fired type, operating in the 135°C range.

Fabrication

Twisting and Plying

Continuous filament yarn is made by twisting and/or plying a number of glass fibers.

The twisting operation gives a uniform thread-like character to the fibers, which may then be plyed together to give heavier yields. Fabrics made with Fiberglas textile yarns are used as a reinforcement in many plastic products. These yarns are also used to insulate electrical equipment, while glass textile reinforced paper tape helps make cartons that are stronger.

Multiple Winding

The Multiple Winding Department produces braider tubes, which are used in the production of braided sleeving, in electrical wire and cable applications, and in the reinforcement of steam hose. Braids are formed also over electrical wire for insulation purposes, and over Fiberglas filler, to form a core for winding heater and resistor wires.

Tire Cord

Glass fiber has been used in the construction of glass-belted bias ply tires since 1967, some radial tires and in construction of drive belts.

Fiber from the forming department, after drying, is impregnated with a latex solution and cured in an oven at temperatures of about 350°C. The latex coating allows the cord to bond to the rubber in the final product. After curing, the cord is twisted and plyed, preparatory to weaving into belt material by FCI's customers.

Reinforcements

Plastics which are reinforced with Fiberglas mat, chopped strand, woven fabric and roving have hundreds of applications in the automotive, mass transit, chemical, electrical, construction and recreation industries.

Reinforcing Mat

Chopped strand mat, designed for reinforcing polyester resin in contact molding processes, is made from short glass fibers distributed in a random pattern to ensure maximum uniformity in the finished laminate. Mat, a felt-like material, is thin, porous, and highly formable. It is constructed from multiple-length chopped strands, bonded in mat form by a small quantity of polyester resin. Binders may be soluble, or insoluble, depending on the end use requirements. The binders are distributed as a powder onto the mat, and cured at temperatures of about 200°C in an oven. Emissions from the oven pass through a filtration system prior to discharge.

Roving

Fiberglas roving is made by gathering a number if continuous filament strands and

winding them on a cylindrical package. Even tension and positive end counts are available to produce desired yields. The most common end count is 12, providing a yield of 416 meters per kilogram. The parallel strands of continuous roving provide high unidirectional strength.

Chopped Strands

Chopped strands are made by chopping continuous filament strands into desired lengths. These strands may be bonded with a variety of sizings and are primarily used as a reinforcement for manufacturing molding compounds.

Incinerator

A new incinerator was installed on August 10, 1989 to replace the original incinerator to control the emissions from #1 tire cord line. The new incinerator is a natural gas fired unit which operates at a temperature at 900°C, and with a minimum gas retention time of 0.75 seconds. The new incinerator exhausts through a stack 17.7 m above grade. The exhaust system for #1 cord line has been redesigned so that all sources of fume laden air are now captured and burned in the incinerator.

(B) Fiberglas Canada Chemical Plant

The FCI Chemical Plant in Guelph, Ontario, produces polyester resins, gelcoats and colour pastes used by fabricators in the glass reinforced plastics business.

Raw materials such as phthalic anhydride, maleic anhydride, ethylene glycol or propylene glycol are reacted together in various proportions depending on the desired product properties. Raw materials are charged to either of two temperature controlled reactors to produce a polyester alkyd which is then thinned using styrene to produce a base resin which may go directly to storage, or directed to a formulation tank in which various thixotrope or promoter additives are used to produce a formulated resin as final product.

A byproduct of the polyester reaction is water of esterification, evolved as steam during the reaction. This material passes through a condenser to liquify the water and heavier organic materials, primarily glycol. Light hydrocarbons, such as propionaldehyde, which are not condensed, are passed through a countercurrent, packed bed water scrubber to remove the organics from the vapour stream. The scrubbed gases are then passed through a charcoal bed for further removal of organics, and then vented to atmosphere. The water of esterification, contaminated with glycol and some light hydrocarbons, together with water from the vent scrubber, is stripped to separate out the light-end organics from the water/glycol solution. The organic rich waste stream is disposed of as hazardous waste for incineration off-site. The water and glycol is recirculated back to the vent scrubber

and also diverted to another distillation process to produce organic-free water which is discharged to sewer through a neutralization system. The glycol is reclaimed for reuse.

In addition to the major process, there are a number of blending and finishing operations to produce coloured gel coats and colour pastes as well as specialty resins which are cooled and advanced to solid form.

Production Information

Levels of Production

(A) **Fiberglas Canada fabric plant**

Area	Aug. 8	Aug. 9	Aug. 10	Aug. 11	Aug.14	Aug.16
Forming Dept.	75%	75%	75%	75%	75%	75%
Drying Ovens (5 out of 7 operating)	71%	71%	71%	71%	71%	71%
Chopped Strand Schedule Mat Line (Downtime)	100% 07:00-19:00 (12 hrs) 11:00-11:35 15:00-15:35 19:00-07:00	100% 11:00-07:00 (20hrs) 07:00-11:00 11:00-11:35 15:00-15:35 23:00-23:35	100% 07:00-07:00 (24hrs) 11:00-11:35 15:00-15:35 23:00-23:35 03:00-03:35	100% 07:00-7:00 (24hrs) 11:00-11:35 15:00-15:35 23:00-23:35 03:00-03:35	100% 19:00-07:00 (12hrs) 07:00-19:00 23:00-23:35 03:00-03:35	100% 07:00-07:00 (24hrs) 11:00-11:40 15:00-15:40 23:00-23:35 03:00-03:40
Tire Cord Lines positions running (% of capacity)	72 (46.2%)	72 (46.2%)	0	84 (53.8%)	84 (53.8%)	84 (53.8%)
Hours Schedule	24	24	0	2 16:00-18:00	24	24
Downtime	0	0	24	22	0	12:00-16:06
Line Operating	#2	#2	--	#1	#1	#1

(B) Fiberglas Canada Chemical Plant

Rate of production at the plant varies considerably according to market demand. At the time of the TACA survey, August 17, 1989, the plant was producing standard commodity resins at about 85% of ultimate capacity.